

CLAIMS

1. A laser module, comprising:

a sub-mount;

5 a semiconductor laser secured to a surface of the sub-mount; and
an optical waveguide device joined to the surface of the sub-mount
by an adhesive layer so that the optical waveguide device is coupled
optically with the semiconductor laser,

wherein a first groove is formed at the surface of the sub-mount at a
10 region corresponding to an incident end side of the optical waveguide device,
the first groove being formed parallel to an outgoing end face of the
semiconductor laser with a predetermined space therefrom, and

the adhesive layer is formed so that an end of the adhesive layer on
the incident end side of the optical waveguide device is positioned within a
15 range from a position abutting with a distal edge of the first groove distant
from the semiconductor laser to an inside of the first groove and does not
contact with the outgoing end face of the semiconductor laser.

2. The laser module according to claim 1, wherein a distance D

20 between the outgoing end face of the semiconductor laser and a proximal
end of the adhesive layer satisfies $0 \text{ mm} < D < 0.2 \text{ mm}$.

3. The laser module according to claim 1, wherein the adhesive layer is
provided partially at one position close to an incident end face of the optical
25 waveguide device.

4. The laser module according to claim 1, wherein the adhesive layer is
provided partially at least at two positions, close to an incident end face of
the optical waveguide device and close to an outgoing end face of the optical
30 waveguide device.

5. The laser module according to claim 4,
wherein a second groove is formed at the surface of the sub-mount at
a region corresponding to an outgoing end side of the optical waveguide
device, the second groove being formed parallel to the outgoing end face of
the optical waveguide device, and
the adhesive layer close to the outgoing end face is provided along
the second groove.

6. The laser module according to claim 4, wherein an area of the
adhesive layer close to the incident end face is larger than an area of the
adhesive layer close to the outgoing end face.

7. The laser module according to claim 1, wherein a third groove is
formed at the surface of the sub-mount at a region corresponding to the
incident end side of the optical waveguide device, the third groove being
formed parallel to the first groove and being positioned between the first
groove and the outgoing end face of the optical waveguide device.

8. The laser module according to claim 7, wherein a distance L_1
between the first groove and the third groove satisfies $1\text{ mm} < L_1 < L/2$,
where L denotes a length of the optical waveguide device.

9. The laser module according to claim 5, wherein a fourth groove is
formed at the surface of the sub-mount at a region corresponding to the
outgoing end side of the optical waveguide device, the fourth groove being
formed parallel to the second groove and being positioned between the
second groove and the incident end face of the optical waveguide device.

10. The laser module according to claim 9, wherein a distance L_2

between the second groove and the fourth groove satisfies $1\text{ mm} < L_2 < L/2$, where L denotes a length of the optical waveguide device.

11. The laser module according to claim 1, wherein a thickness T_1 of the optical waveguide device satisfies $T_1 < 1\text{ mm}$.

12. The laser module according to claim 1, wherein a width W of the optical waveguide device satisfies $W < 0.85\text{ mm}$.

13. The laser module according to claim 1, wherein a length L of the optical waveguide device satisfies $L > 10\text{ mm}$.

14. The laser module according to claim 1, wherein a thickness T_2 of the sub-mount satisfies $T_2 < 0.3\text{ mm}$.

15. The laser module according to claim 1, wherein the optical waveguide device is a quasi-phase-matched second harmonic generation (QPM-SHG) device.

16. The laser module according to claim 1, wherein the optical waveguide device is an optical fiber.

17. A method for manufacturing a laser module comprising a sub-mount; a semiconductor laser secured to a surface of the sub-mount; an optical waveguide device joined to the surface of the sub-mount by an adhesive layer so that the optical waveguide device is coupled optically with the semiconductor laser, and a package to which the sub-mount is secured, the method comprising the steps carried out in this stated order:

forming a groove at the surface of the sub-mount at a region corresponding to an incident end side of the optical waveguide device and

securing the semiconductor laser at a predetermined position close to the groove so that an outgoing end face of the semiconductor laser is parallel to the groove;

5 providing the adhesive layer so that an end of the adhesive layer on the incident end side of the optical waveguide device is positioned within a range from a position abutting with a distal edge of the first groove distant from the semiconductor laser to an inside of the first groove and does not contact with the outgoing end face of the semiconductor laser, and joining the optical waveguide device to the surface of the sub-mount by the adhesive
10 layer; and
securing the sub-mount to the package.

18. A method for manufacturing a laser module comprising a sub-mount; a semiconductor laser secured to a surface of the sub-mount; an
15 optical waveguide device joined to the surface of the sub-mount by an adhesive layer so that the optical waveguide device is coupled optically with the semiconductor laser, and a package to which the sub-mount is secured, the method comprising the steps carried out in this stated order:

forming a groove at the surface of the sub-mount at a region
20 corresponding to an incident end side of the optical waveguide device and securing the semiconductor laser at a predetermined position close to the groove so that an outgoing end face of the semiconductor laser is parallel to the groove;

securing the sub-mount to the package; and
25 providing the adhesive layer so that an end of the adhesive layer on the incident end side of the optical waveguide device is positioned within a range from a position abutting with a distal edge of the first groove distant from the semiconductor laser to an inside of the first groove and does not contact with the outgoing end face of the semiconductor laser, and joining
30 the optical waveguide device to the surface of the sub-mount by the adhesive

layer.

19. The method for manufacturing a laser module according to claim 17 or 18, further comprising: after completion of all of the steps, pouring an
5 adhesive into a gap between a position close to an outgoing end face of the optical waveguide device and the sub-mount, whereby the position close to the outgoing end face of the optical waveguide device is secured to the sub-mount.